

## **REMARKS/ARGUMENTS**

This Reply is in response to the Office Action dated November 29, 2004 and is accompanied by a petition for a two-month extension of time, and an authorization to charge the small entity extension fee to Deposit Account No. 50-0951.

Claims 1-6, 8-10, 17-26 and 29-37 were pending at the time of the Office Action. Claims 1, 6, 17-21, 26, 29, and 31-37 were rejected under 35 U.S.C. § 102(e) as being anticipated by Hampden-Smith et al. (U.S. 2002/0003225 A1). Claims 33 and 34 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hampden-Smith as applied to claim 1. Claims 2-5, 8-10, 22-26, and 30 were objected to as being dependent upon a rejected claim but were determined to be allowable if rewritten in independent form.

In this Reply, claims 1, 6, 8, 9, 10, 17, 18 and 37 have been amended. Applicants note that the amendment to claim 17 is supported on Page 31, paragraph 3. No new matter has been added.

In the Office Action claim 37 was objected due to a misspelling. As amended, the misspelling that had been recited in claim 37 is now corrected.

As noted above, claim 8 which was objected to as being dependent upon a rejected claim but was determined to be allowable if rewritten in independent form. Claim 8 has now been written in independent form. Accordingly, claim 8 as amended is an allowable claim.

Before reviewing claim rejections based on cited art, Applicants will first review the claimed invention as now recited in amended claim 1. As amended, claim 1 recites a slurry for chemical mechanical polishing (CMP) comprising a bulk solution, a plurality of particles, wherein the particles are nanosize (<1 µm) nanoporous comprising particles. Nanoporous particles have a plurality of pores which are generally significantly smaller than the particle size,

such as 0.2 nm to 20 nm pore sizes. Such nanoporous particles are described in Applicants' application in several places, including Figs. 6(a)-(c) which show TEMs of nanosize nanoporous core particles. The nanoporous particles are about 50 nm as shown in Fig. 6(a), about 80 to 100 nm as shown in Fig. 6(b) and about 120-160 nm as shown in Fig. 6(c). Page 31, paragraph 3, which is copied below, also describes nanoporous particles.

Nano-porous silica particles can be formed by a modified Stober process (W. Stober, A. Fink, E. Bohn, J. Colloids and Interfacial Science, 26, 62-69 (1968)). The particle size can vary from 200 nm to 500 nm, while the porosity can vary from 10 to 60 %. As the porosity of the surface increase the number of adsorption sites are expected to increase. Figure 6 shows TEM photographs showing different sizes of nanoporous core particles. The particles are mono-dispersed and spherical in nature. It is noted that the aspect ratio of particles can be changed using alternate formation methods.

Nanoporous coating are also disclosed by Applicants on page 37, lines 5-18:

A preferred embodiment of the invention uses silica or silica inorganic cores coated with surfactants to form a hard core-soft shell structure. The inorganic core can be silica, doped silica, porous silica, or hard particle (Mohs hardness greater than 3.0) coated with silica, doped silica, or a porous silica layer. For silica/nanoporous or silica/nanoporous silica coated inorganic cores the preferred surfactant is cationic, zwitterionic, or a mixture of cationic/non-ionic surfactant or with a cationic surfactant with generally less than 1% of an anionic additive. Examples of preferred cationic based surfactants for silicon dioxide include CTAB, and CTAC, and their derivatives and chemical equivalents. The carbon chain length in the surfactant molecule is preferably from 8 to 20. Other examples of preferred surfactants for silicon dioxide include zwitterionic surfactants, such as KETJENLUBE 522<sup>®</sup>. The concentration of the surfactant can be from 0.1 of a bulk critical micelle concentration (CMC) of the solution to 1000 times CMC. Preferably, the surfactant concentration is from 0.4 of the CMC to 100 times CMC. The bulk CMC value of the surfactant is defined as the minimum concentration at which the surfactant self assembles to form structured layers in a bulk solution.

The claimed nanosize nanoporous slurry particles provide unexpected and highly advantageous results, particularly when used in conjunction with Applicant's selective adsorption additive comprising slurry. Specifically, in this arrangement, because of the porous structure of the particle surface, the adsorption of surfactants or polymer additives can occur at different, and generally lower, concentrations as compared to bulk particles.

According to the Examiner on page 4 of the Office Action:

Hampden-Smith also teaches,  
wherein said second solid material coating said first solid material comprises a  
nanoporous material [0233 – 0234], in claim 6; and

Applicants respectfully disagree with the above assertion. Paragraphs 233 and 234 of Hampden-Smith are copied below for convenient reference to demonstrate that porous particles are not disclosed or suggested in the above cited paragraphs:

[0233] According to another embodiment of the present invention, the abrasive particles can be coated abrasive particles that include a particulate coating (FIG. 47d) or non-particulate (film) coating (FIG. 47a) on the outer surface of the particles. The coating for abrasive particles is a preferably non-metallic coating, such as a metal oxide or an organic compound. Preferably, the coating is very thin and has an average thickness of not greater than about 200 nanometers, more preferably not greater than about 100 nanometers, and even more preferably not greater than about 50 nanometers. While the coating is thin, the particulate or non-particulate coating should substantially encapsulate the entire particle. Accordingly, the coating preferably has a thickness of at least about 5 nanometers. The coating can be, for example, silica, alumina or ceria. In one embodiment of the present invention, the abrasive particle comprises SiO<sub>2</sub> with an Al<sub>2</sub>O<sub>3</sub> coating encapsulating the SiO<sub>2</sub> core or SiO<sub>2</sub> particles with a CeO<sub>2</sub> coating. Such coatings can be produced in a manner discussed hereinabove. Such coatings can advantageously provide accurate control over the particle density, for example when a high density coating is placed on a low density particle, and can also provide control over the chemical and mechanical action of the particles during polishing.

[0234] The abrasive particles can also include a coating of an organic compound such as PMMA (polymethylmethacrylate), polystyrene or the like. The organic coating preferably has a thickness of not greater than about 50 nanometers and is substantially dense and continuous about the particle. The organic coatings can advantageously prevent corrosion of the particles and also can improve the dispersion characteristics of the particles in the slurry. For example, a coating can influence the redox characteristics of the particles. Such coatings can also extend the shelf-life of the slurries. Presently available slurries have a limited shelf-life primarily due to the high surface area of the particles, which exposes the surfaces to the slurry components, causing the surfaces to become hydrophobic.

Applicants do note that Paragraph 227 of Hampden-Smith (copied below) does mention porous particles:

However, for some applications, particularly when *larger sized particles* (e.g. 2-3 µm) are utilized, it may be advantageous to use hollow or porous particles to lower the particle density and enhance the stability of the particles in the slurry, particularly when the abrasive compound is a relatively high density compound. Hollow particles allow the abrasive to remain

stable in the slurry for a longer period of time, leading to a more stable slurry and eliminate the need for point-of-use mixing of the abrasive particles and the other slurry components. The methodology of the present invention advantageously permits control over the morphology of the particles in this regard. Such larger, hollow particles can be formed with sufficient compressive strength to be used for CMP polishing without crushing and fragmenting. (italics for emphasis only)

Although porous particles are disclosed above by Hampden-Smith, Hampden-Smith teaches use of porous slurry particles when "larger sized particles (e.g. 2-3  $\mu\text{m}$ )" are used "to lower the particle density and enhance the stability of the particles in the slurry". Accordingly, Hampden-Smith teaches away from Applicants' claimed nanosize nanoporous (< 1 micron) particles. Moreover, by noting that the larger sized porous particles are "hollow particles", Hampden-Smith generally teaches particles having one large microscale hole which means the particles have a porosity which is generally >90%. In contrast, the claimed nanosize nanoporous particles have a large number density of small nanosized pores as opposed to the hollow porous particles of Hampden Smith. For example, as now claimed in amended claim 17, a porosity of Applicants' claimed nanosize nanoporous particles can be in a range from 10 to 60 %. Moreover, as noted above, the nanoporous particles claimed by Applicants provide more than a difference in particle size and porosity as compared to the particles disclosed by Hampden-Smith. Specifically, as noted above, Applicants' claimed slurry particles provide unexpected and highly advantageous results, particularly when used in conjunction with Applicant's selective adsorption additive comprising slurry, since because of the nanoporous structure of the particle surface, the adsorption of surfactants or polymer additives can occur at different, and generally lower, concentrations as compared to conventional bulk particles.

Accordingly, in view of the above, Applicants submit amended claim 1 is patentable over the cited art, and several dependent claims provide independently patentable limitations. Applicants have made every effort to present claims which distinguish over the cited art, and it is

believed that all claims are now in condition for allowance. However, Applicants request that the Examiner call the undersigned if anything further is required by the Examiner prior to issuance of a Notice of Allowance for all claims.

Respectfully submitted,

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